whole. The book gives useful samples of profitable nature-studies, *e.g.* of a river or of a wasp nest, but more should have been made of the remarkably fine collection of illustrations. We may also point out that there is an unpleasant smack in some of the much too ambitious titles—"How to know the Insects," and so on.

(5) Mr. Westell's guide to the natural history of the sea and seashore contains much interesting information, somewhat carelessly stated, and many of the illustrations are very fine. In many cases the coloured plates do not show the natural colours, and the text contains many errors. It is a pity to speak of the "bones of starfish," of the Bass Rock as a "remarkable headland," of Luidia as "one of the largest British brittle-stars," of Polycystina as "shell-fish." Mr. Westell refers frequently and gratefully to Miss Newbigin's admirable "Life by the Seashore," but the fact that he never spells her name correctly is a trivial illustration of the carelessness which disfigures his book.

FIG. 2.—Hedgehog and Grass-snake. From "The Nature Book."

(6) Mr. Charles G. D. Roberts writes a picturesque book about beavers, bears, wolves, moose and other Canadian animals, and tells a good story. There is convincing work in his nature-studies, and "From the Teeth of the Tide" is uncommonly well done. It is unlikely that the author meant his tales to be included under the serious rubric of "nature-study," but they may help some to get away from the fallacious automatic-machine theory of the creature.

(7) What are the ends of nature-study, for they are many? We are told that this discipline—which is now part of the day's work of the elementary school—"implies an appreciative outlook upon the whole environment, and that not from a scientific view-point only, but from the æsthetic and practical as well." Thus among the aids to nature-study which have sprung up on demand with almost magical quickness, some emphasise precise observation and others graphic registering; some the cultivation of the school garden, and others the culture of the scientific mood; and all this is well if it be well done. But that there is something more than all this a book like Mr. M'Conachie's reminds us, for it expresses an end of nature-study which, if attained, covers a multitude of sins, but without which the naturalist with his lynx eye is a fingering slave, and the school garden only an open-air laboratory. That end is the love of the country, which is to be felt, not spoken about. Mr. M'Conachie does not speak of it, except, perhaps, in the repellent title of his book, which is congruent, however, with his vocation, but his pictures, which are worthy of a place beside those of Jefferies and Burroughs, reveal it eloquently. He knows his birds and his flowers not as species so much as familiar friends; he takes us, not on botanical excursions, but for a walk in the country, and we return wondering whether it was poet or naturalist who led us. *Nur was du fühlst das ist dein Eigenthum,* and no one can read these sketches—such as the coming of spring, the promise of summer, the turn of the year, and December days—without feeling that the author has made the natural history of the year his own in the truest sense. Many of the sketches are local; but though we have never been very near the Scotch parish which contains the quarry pool, the brook path, the mill stream, the haunt of the pike, and the old forest that we now know, there is so much of the universal in the pictures that we seem to have known and loved them for many years. To all who would know the true inwardness of nature-study we commend this book. J. A. T.

LIEUT. SHACKLETON'S ANTARCTIC EXPEDITION.

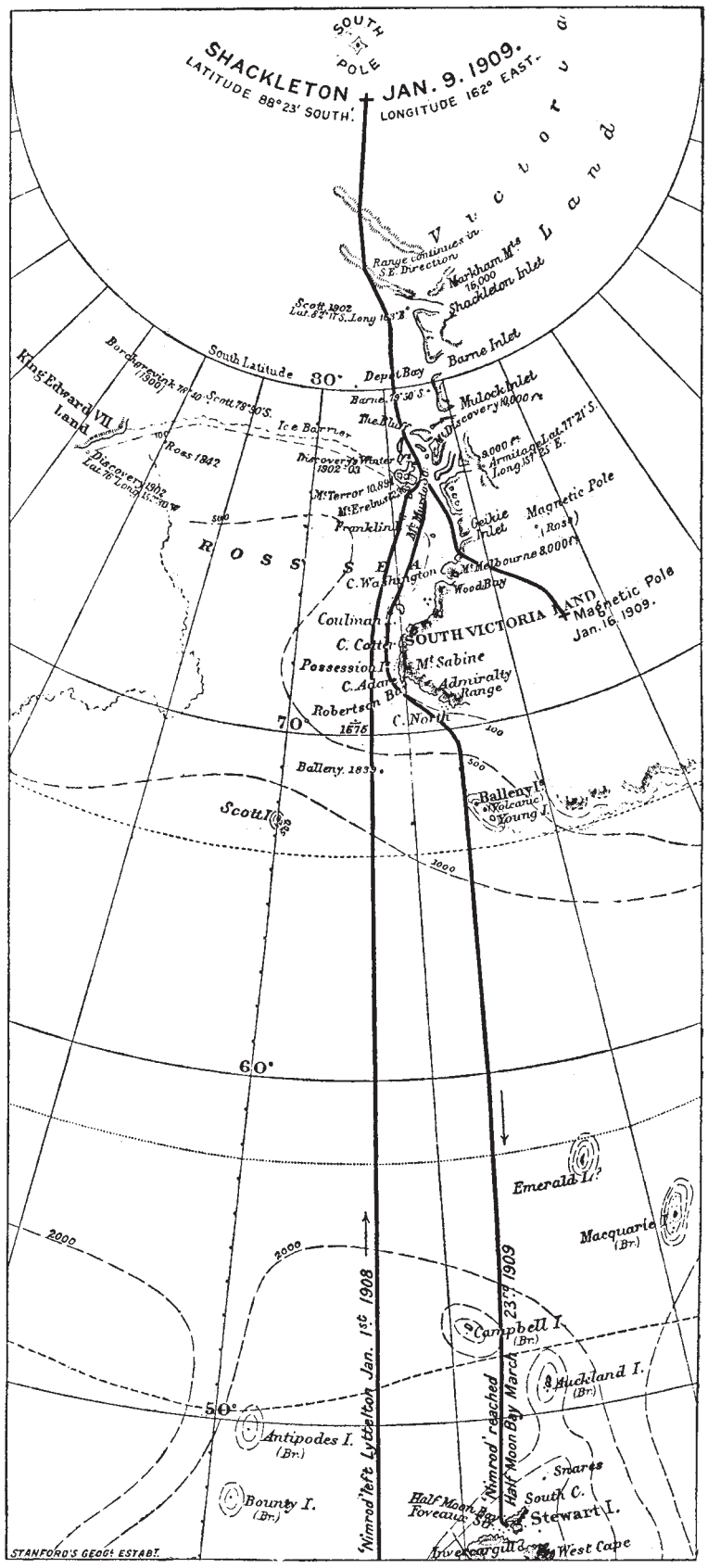
(1) EXPLORATIONS AND RESULTS.

THE anxiety occasioned by the delay in the return of Lieut. Shackleton's expedition has been relieved by its safe arrival and the news of its supreme success. A cable published in the *Daily Mail* of March 24 records the magnificent exploits of the expedition, and though there are occasional obvious verbal inaccuracies in regard to some technical points, the report makes clear the main outlines of its great achievements. They unquestionably place it in the front rank of Polar expeditions. Its two most striking achievements were the sledge journeys by which Lieut. Shackleton reached within one hundred geographical miles of the South Pole, and discovered the nature of the very centre of the South Polar region, and by which Prof. David gained the magnetic south pole, and rendered almost certain the continuity of South Victoria Land and Wilkes Land.

The expedition was landed early in 1908 near the

former winter quarters of the *Discovery* on MacMurdo Sound, and there established its main base. It gained its first success by the ascent of Mount Erebus (13,120 feet high), and the discovery of its old crater at the height of 11,000 feet. During the winter depôts were established in readiness for the summer journeys, and in this work the motor-car proved of great service over the sea ice, though it could not be used on the land ice or on the Barrier.

The southern sledging party—Lieut. Shackleton, Lieut. Adams, Mr. Marshall, the surgeon, and Mr. Frank Wild—left Hut Point on November 3, 1908. On November 5 the explorers were stopped by a blizzard, which delayed them for four days; thanks to their pony sledges progress southward was rapid, and on November 13 they reached a depôt previously formed at latitude 79° 36′. The route selected was along the meridian of 168° E., to the east of that followed by Capt. Scott's party. The Ice Barrier proved to have an undulating surface, and from the brief reports much of the upper part of it appears to be composed of snow. The previous southern record was passed on November 26, and about eighty miles further south the Great Ice Barrier appeared to end as "the ridges of snow and ice turned into land." At this point, 83° 33 S. and 172° E., Lieut. Shackleton began the ascent of a great glacier, which was so crevassed that on December 6 the party only advanced 600 yards in the one day. It may therefore be inferred that progress to the south was blocked by the mountains on the eastern margin of South Victoria Land bending round to the east, and, judging from the crevassed nature of the ice, the face of the plateau is very steep. On December 8 the air was clear, and some new mountains were discovered trending southward and south-westward. The glacier by which the route on to the ice plateau was achieved appears to have been badly crevassed throughout, and it took twelve days to reach an altitude of 6800 feet. Everything that could be spared was left behind in a depôt at 85° 10′ S., and on reduced rations the party struck southward toward the Pole, forcing their way against southern blizzards. Eight days' march over undulating, and apparently in places very broken, ice led to the summit of the plateau at the height of 10,500 feet. The mountains had disappeared in the distance by December 27, so probably they were a mountain range striking westward from those along



the margin of the plateau. Once again equipment was lightened as the available time was nearly spent. Nearly the whole of three precious days, January 7 to 9, were lost by a blizzard, with a wind estimated at seventy miles an hour, and a temperature of 40° below zero. The conditions improved on January 9, and upon that day the expedition attained its most southern point, 88° 23′ S. in 162° E. From that position no mountains were visible, and so far as could be seen the country to the south consisted of an ice plateau.

The return journey necessarily followed the same route, and the party were harassed by the bad condition of the snow, and illness due to their privations and over-exertion. They were fortunately helped most of the way by the strong southern wind. Two of the party collapsed, but Shackleton and Wild obtained help from the ship, and the party were all safe at Hut Point on March 4, after a brilliant journey of 1708 miles in 126 days.

Meanwhile a party consisting of Sir Philip Brocklehurst, Mr. Priestley, of Bristol, a geologist, and Mr. Armytage, were at work in the neighbourhood of the Ferrar Glacier; while Prof. David, of Sydney, Mr. Mawson, of Adelaide, and Mr. Mackay, as surgeon, were engaged on a brilliantly successful sledging expedition into northern Victoria Land. The party crossed from Hut Point to the mainland at Butter Point (77° 40′ S.); thence it sledged northward on sea ice to the latitude of about 75°, and then endeavoured to climb on to the plateau through the gap between Mounts Nansen and Larsen. That route was abandoned, but the report does not state by what line the inland ice sheet was eventually gained. The party experienced strong southerly winds and temperatures of 18° below zero, and on January 16 reached its goal, the Magnetic South Pole, at 72° 25′ S., 154° E. The report describes this journey as extending for 260 statute miles north-west of their depôt on the coast; and this distance would have taken them half-way across the country to the shore of Wilkes Land. On their arrival at the shore their retreat was found to be cut off by the dispersal of the ice, and Prof. David and his comrades were finally rescued by the *Nimrod* on February 4. This magnificent journey not only gained the Magnetic Pole, but renders almost certain the continuity of the ice plateau from South Victoria Land to Wilkes Land.

The scientific and geographical results of the expedition are obviously both of the highest importance. The main object of the expedition was to get as near as possible to the South Pole; but that sentimental interest led the expedition along the line of greatest scientific interest. All preliminary investigations on central Antarctica depend on its topography, and the South Pole lies in the very centre of the unknown region. The route to it was the most illuminating that could have been followed. Further details as to the nature of the southern mountain ranges discovered by the expedition in latitude 86° and 87° will be awaited with the keenest interest, in the hope that they may throw light on the connection between South Victoria Land and Graham Land.

The result of the expedition appears to confirm the prediction as to the probable nature of the South Polar area suggested in an article on Antarctic research by Prof. J. W. Gregory in NATURE in 1901. It was there suggested that the chief mountain chain in Antarctica would be found to lie along a line connecting Graham's Land and the coast of Victoria Land, and that "to the south of the main mountain range there may be an undulating, ice-covered region descending slowly across the Pole to the shore of the Weddell Sea. The main ice-drainages would then be not from the Pole radially in all directions; the ice-shed would run along the Pacific shore with a short, steep northern face and a long, gradual slope southward to the Pole and across it northward to the Atlantic" (NATURE, vol. lxiii., 1901, p. 612).

This view is now apparently fully confirmed by Lieut. Shackleton's report that the geographical South Pole "is doubtless situated on a plateau ten to eleven thousand feet above sea-level." The mountains that he discovered range from three thousand to twelve thousand feet in height, so though lower than some of the peaks in northern Victoria Land, the great altitude of the plateau is maintained.

This conclusion as to the structure of the South Polar district had been regarded as so probable from the work of the National Antarctic Expedition that the north-western sledging expedition under Prof. David throws perhaps equally important light on the structure of Antarctica. For the journey 260 miles north-west from their depôt on the shore of the Ross Sea carried them almost into Wilkes Land. The altitude of the southern magnetic pole is not stated, but judging by the distances marched, most of the route probably lay over an undulating ice plateau, which probably extends northward to the coast of Wilkes Land.

Of the meteorological results the most striking that can be learnt from the cable is the wide distribution of prevalent southerly winds, blowing with the force of blizzards even to the farthest south. So that elusive South Polar anticyclone has not yet been found, and if it exists at all must be situated on the Atlantic side of the South Pole. If so, the ice-covered plateau around the South Pole may keep at a high altitude for a great distance from the Pole towards the Weddell Sea.

The zoological results are said to be valuable, and the announcement of the collection of many rotifers, infusorians, and other organisms in the freshwater lakes, by Mr. James Murray, is of particular interest.

The geological results may be expected to throw light on many important problems. Lieut. Shackleton reports the discovery of "Coal-measures in limestone" apparently among his southern mountains. This statement probably means that the rocks containing the carbonaceous material found by Mr. Ferrar near the *Discovery* winter quarters extend into the southern mountains, and are there associated with limestones. The only definite fossils referred to are some radiolaria discovered by Prof. David in boulders. They may be of any age, but, considering the resemblance of the slates of Cape Adare to those of the Lower Palæozoic rocks of southern Australia, it will not be surprising if these radiolaria prove to belong to that series. As no other fossils are referred to, their absence, or at least their rarity, suggests that the area was under severe climatic conditions during the deposition of all the sedimentary rocks discovered.

Prof. David reports that the chief Antarctic bergs are snow-bergs, and this announcement and Lieut. Shackleton's description of the nature of the ice barrier both confirm the conclusion as to its origin advocated in the review of Captain Scott's book in NATURE (vol. lxxvii., p. 298), viz. that this ice had not been formed from the glaciers but from sea ice "by the accumulation of layers of snow upon the surface more quickly than the ice was dissolved by the sea beneath." A photograph of the face of the barrier was reproduced to show that its material resembles ice formed from cemented stratified snow rather than glacier ice. The method of its probable formation was also illustrated in NATURE (vol. lxxvii., p. 561) by a photograph from the report on the geology of South Victoria Land.

The tectonic geography of Victoria Land, we may

now expect, will be conclusively settled, as the expedition fortunately had with it Prof. Edgeworth David, of Sydney, who determined the monoclinal structure of eastern New South Wales. The first geological information regarding South Victoria Land announced by the *Discovery* suggested that the country was a typical representative of the Pacific coast type; but this conclusion has been regarded as improbable by Dr. Prior and Herr Emil Philippi on petrographic grounds. But that evidence will not give the final test, and the data collected by the National Antarctic Expedition render it probable that the coast of South Victoria Land is of the sub-Pacific type, agreeing essentially with that of the eastern coast of Australia. As the greatest authority on the geology of that coast was a member of the expedition, he may be trusted to give this question its final solution.

The expedition is a great triumph for Lieut. Shackleton. The greatness of his results is not merely due to the distance by which he surpassed previous southern records, but to his having, in the far south, left the low-level ice and climbed on to the plateau and discovered its nature in close proximity to the Pole. He would probably have added little further of scientific value by going another one hundred miles southward, for he no doubt saw enough to justify his belief that the ice plateau continued across and beyond the Pole. The results of his journey show him to be a great leader as well as a bold pioneer. He inspired his colleagues with implicit confidence, and the rich harvest secured in one short season's work is due not only to his energy and personal courage, but to his full use of the capacities of every member of his staff. He had the nerve as a commander to run great risks by scattering his forces, and the judgment that enabled him to avoid disaster. The messages of congratulation which have been sent to him by the King and Queen, the Royal Society, and the Royal Geographical Society, represent the warm feeling of national pride and satisfaction at the remarkable achievements of the expedition.

(2) The South Magnetic Pole.

The position obtained by the Shackleton expedition for the south magnetic pole is lat. 72° 25′ S., long. 154° E. It may be of interest to compare the position thus indicated with earlier results. The first observational data enabling an approximate position to be assigned were those obtained by Sir J. Ross about sixty-five years ago. General Sabine's Antarctic declination chart based on these observations places the pole at about 73½° S., 147½° E. In chart vi. attached to vol. ii. of Prof. J. C. Adams's "Collected Papers," the position deduced from Ross's data is about 73° 40′ S., 147° 7′ E. The next observational data are those of the *Southern Cross* expedition of 1898–1900, consisting of dip observations made by the magnetic observer, Mr. L. C. Bernacchi. In the discussion of these by Mr. Bernacchi and the present writer the approximate position deduced for the Pole at the epoch 1900 was 72° 40′ S., 152° 30′ E. The National Antarctic Expedition of 1901–4 provided a much more copious series of observations. The dip and the declination observations, treated independently by Commanders L. W. P. Chetwynd, R.N., and F. Creagh-Osborne, R.N., gave almost identical positions, the mean finally accepted[1] being 72° 51′ S., 156° 25′ E. The position of the pole undergoes presumably slow secular change, and unless the regular diurnal and the irregular changes of terrestrial magnetism in its immediate neighbourhood are totally different in character and size from those a few hundred miles away—an unlikely contingency—there is probably a more or less regular diurnal change of position, in which the pole (if defined as the spot where the dipping needle is vertical) describes an oval curve several miles in diameter. Superposed on this are doubtless irregular excursions, which may occasionally be of much larger amplitude. Owing to the low directive force on the compass needle, and the extent to which it is affected near a magnetic pole by irregular disturbances, the members of the expedition were probably well advised in using a dip circle, especially if they observed in two perpendicular planes, so as to get rid of the uncertainty in the position of the magnetic meridian. Magneticians will await with interest a detailed account of the method of observation adopted, and the exact nature of the results obtained.

C. Chree.

[1] National Antarctic Expedition, 1901–4. Physical Observations, p. 156.

(3) Meteorological Observations.

The information available in the summary of the results of Lieut. Shackleton's expedition does not enable us to go much further into the interesting question of the Antarctic anticyclone, but it is noteworthy that Lieut. Shackleton, like Capt. Scott in his journey to the south, experienced strong and persistent southerly winds. From the time he reached the plateau at an altitude of about 10,000 feet on December 26 until the return to the ship we find constant mention of a "southerly blizzard," the wind behind the party greatly facilitating the return journey. From the observations of temperature, which must, of course, be scanty until sufficient time has elapsed for mails to be received, it would appear as though the surface temperature on the barrier ice and that on the high plateau were not very different, notwithstanding the difference of 10,000 feet in the altitude. In ordinary climates this difference means a fall of 33° F. in the temperature. On reaching the summit the temperature ranged from −5° to −38°. The blizzard which detained the party during January 7, 8, and 9 had a temperature of −40° (rather a different kind of thing, probably, from the so-called English blizzards of which we have heard so much of late). On the barrier-ice temperatures of −18° and −35° F. are given, so that the conditions do not seem to have been more severe at the greater altitude. In the Alps, and the rule is probably general, a small vertical temperature gradient is associated with anticyclonic conditions; if full information, when it is received, bears out this inference of the slight or non-existent fall of temperature with height, it will go far to establish the belief in an Antarctic anticyclone.

But the persistent southerly winds are hard to explain, though we can hardly now doubt their existence on the western part of the great ice barrier. On the slope to the southward they may be due to the same causes that make a wind blow down a valley at night, and on the barrier ice, as Mr. R. H. Curtis has stated, an east or south-east wind may be deflected into a south wind by the range of mountains to the westward. On the plateau neither explanation will serve. It is just possible that the south is not the prevailing wind there, since a month is not long enough to show the prevailing direction.

Probably the blizzards of these regions are extremely shallow, for it was noted during the expedition of Capt. Scott that the motion of the barometer was of very little use in foretelling the weather, and the winds, therefore, cannot be of the same character as those to which we are accustomed.

Lieut. Shackleton and his companions are certainly to be congratulated on the excellent results they have achieved, and on their safe return. Many Arctic and Antarctic expeditions have shown that, apart

from scurvy, which can now be avoided, extreme cold is not unfavourable to health, but the magnitude of the results and the absence of serious accidents in the face of such difficulties are beyond all praise.

W. H. DINES.

(4) BIOLOGICAL RESULTS.

As regards the biological results of Lieut. Shackleton's achievement, little can be inferred from the tantalisingly brief statements made in the telegrams. That there will be news of great interest is certain, for Mr. James Murray, whose skill and perseverance as an investigator were proved in the course of the Scottish Lake Survey, is not one to have failed in making the most of his unique opportunity. There is biological as well as geological interest in the report—rich deposits of foraminiferal mud (with abundant Biloculina) 40 feet above sea-level, of radiolarian remains in the erratic chert boulders at Cape Royds, and of Coal measures in latitude 85°, with seams of coal 1 foot to 7 feet thick. The frozen fresh-water lakes near Cape Royds contained large sheets of a "fungus-like plant" and abundant diatoms. Many lichens were found and a few mosses. Mr. Murray found abundant infusorians, rotifers, and water-bears (Tardigrada) in the fresh-water lakes, and demonstrated afresh the strong resistance which rotifers have to extremes of temperature. It is well known that many rotifers may survive very thorough desiccation, and that some are able to resist deprivation of air in an ordinary air-pump vacuum. Zelinka showed that Callidina can revive after exposure to −20° C. and immersion in hot water at 70° C.; it will be interesting to hear what fresh instances of plasticity are afforded by Mr. Murray's researches on the microscopic fauna of these polar lakes. One of the despatches says that numbers of rotifers which had been frozen into ice for three years revived after a few minutes' thawing, and began eagerly devouring the fungus that abounds in the lakes. What is probably an unauthorised addendum to the original telegraph credits Mr. Murray with discovering that the southern rotifers are peculiar in being viviparous, but viviparous species of rotifers have been known for a long time. Another crumb of biological information is the report of the ringed penguin at Cape Royds, which extends the record of the southerly range of this bird. The only other crumb requires a grain of salt, for it tells us that the marine fauna near Cape Royds resembles the Carboniferous fauna of Australia.

THE SOLAR RESEARCH UNION.

THE first volume of Transactions, at the first and second conferences, of this International Union has already been noticed in NATURE (vol. lxxv., p. 458).

The present publication concerns itself with the proceedings of the third conference, held at Meudon on May 20–23, 1907, together with reports of various committees of the union, and some original papers which have not appeared previously in an accessible form. As in the case of the first volume, the general editorship has been in the capable hands of Prof. Schuster, chairman of the executive committee.

Of the six parts into which the book is divided the first two consist simply of lists of the scientific bodies constituting the union, delegates present, and men of science invited to take part. The third section, thanks to the excellent record kept by the three secretaries, gives full minutes of the six meetings held during the conference.

The first action of the delegates was to elect as president, by acclamation, M. Janssen, the venerable and illustrious director of the Observatory of Meudon, whose subsequent death has been universally mourned. His short speech, accepting office and returning thanks, was concluded by the following words:—"C'est à vous, Messieurs, que je confie l'avenir de cette science du soleil que j'ai cultivée avec passion pendant plus de quarante années, de cette science des mondes dont j'entrevois l'avenir fructueux. Laissez-moi vous remercier, au moment où je termine ma carrière, de la joie que vous me donnez aujourd'hui."

Mutual helpfulness and coordination, with due regard to the disparity among the equipments involved, might be regarded as the watchwords of the conference. The necessity for these in the spectroscopic determination of the solar rotation periods and in the observation and classification of solar prominences was urged by various members.

M. Perot presented a new measure of the red cadmium line for use as a primary standard, made by MM. Benoît, Fabry, and himself, while the committee on standards of wave-length was given, by resolution, the further duty of preparing a list of secondary standards, to be submitted to the constituent societies, and, if approved by them, adopted by the Union. Both the paper on the red line of cadmium and a further paper by MM. Fabry and Buisson, on the measurement of wave-lengths for the establishment of a system of standard lines, are printed in full.

A complete account of the scheme of sun-spot spectrum observations, suggested by the committee on sun-spot spectra and drawn up by Prof. Fowler, was adopted by the Union, and is incorporated in the Transactions. This scheme allots to each observer a section of the spectrum of about 250 tenth-metres, together with certain other observations outside the special region, but is far from discouraging the initiative of the individual in undertaking further work when opportunity presents itself. The whole of the visible spectrum, in overlapping sections, is already portioned out among the observers available. Though almost without doubt the future of this subject lies with the photographic method, it is a wise policy to make use of the equipments already existing and of the observers already trained in visual observations of spot spectra for a more complete and co-ordinated study than has yet been undertaken. The further knowledge gained will be a welcome endowment for the large sun-spot spectrographs when they are more plentiful than at present.

With regard to the solar constant, resolutions were adopted stating the need for central stations where instruments for this work might be tested and standardised, and indicating the laboratory of M. Ångström at the University of Upsala as the principal central station. A report of the work carried out in the Smithsonian Astrophysical Observatory, relative to the solar constant, is also printed.

The report of the committee on work with the spectroheliograph gives the general programme of observations suggested to the individuals and institutions cooperating in this important work. The need for mutual help, in the interest of progress, is particularly great in work of this character. For intimate study of the rapidly changing solar activities a series of photographs taken as closely together in time as possible is desirable. With a ring of stations round the globe the records at the more westerly would be in sequence after the more easterly, and thus in any one day a series of photographs would

[1] "Transactions of the International Union for Cooperation in Solar Research." Vol. ii. (Third Conference.) Pp. viii+244. (Manchester: University Press, 1908.) Price 7s. 6d. net.